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NESTING AND SUMMER HABITAT USE BY TRANSLOCATED SAGE GROUSE (*CENTROCERCUS UROPHASIANUS*) IN CENTRAL IDAHO

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ABSTRACT.—We translocated 196 Sage Grouse (*Centrocercus urophasianus*) into Sawtooth Valley, Idaho, during March–April 1986–87 to augment a small resident population. Forty-four grouse equipped with radio transmitters were monitored through spring and summer. Nest sites (n = 6) had greater (P = .032) horizontal cover than did independent random plots (n = 7). During summer, grouse used sites (n = 50) with taller live and dead shrub heights, greater shrub canopy cover, and more ground litter (P < .009) than were found on dependent random plots (n = 50) 50–300 m from use sites. Distance to edge and mountain big sagebrush (*Artemisia tridentata vaseyana*) density best separated use sites from independent random plots in logistic regression analysis and correctly classified 64% of the use sites and 78% of the independent random plots. Sage Grouse used sites that had narrower frequency distributions for many variables than did independent plots (P < .04), suggesting selection for uniform habitat.

Key words: Centrocercus urophasianus, *dispersal, habitat use, home range, Idaho, radio telemetry, Sage Grouse, translocation.*

Sage Grouse have been translocated in Montana (Thompson 1946), New Mexico (Allred 1946), Wyoming (Allred 1946, Patterson 1952), Oregon (Batterson and Morse 1948), British Columbia (Hamerstrom and Hamerstrom 1961), and Colorado (C. E. Braun personal communication). Despite numerous early translocation efforts, only one study documented survival of translocated Sage Grouse (Musil et al. 1993), and little is known about habitat use by translocated birds. All spring and summer habitat-use studies (e.g., Klebenow 1969, Oakleaf 1971, Petersen 1980, Schoenberg 1982, Dunn and Braun 1986) involved established Sage Grouse populations.

Historically, Sawtooth Valley in central Idaho supported a population of Sage Grouse (Autenrieth 1981). Prior to 1980, at least six leks were active, but annual surveys by U.S. Forest Service (USFS) and Idaho Department of Fish and Game personnel indicated the breeding population declined from 1981, when 26 birds were seen on two leks, to 1986, when only one lek was attended by one male (A. L. Burton, USFS, interdepartment report). Although causes of the population decline are unknown, rangeland inventories conducted during 1985 and 1986 suggested the available habitat should support Sage Grouse (A. L. Burton, USFS, interdepartment report).

The objective of this study was to document nesting and summer habitat use by Sage Grouse translocated into former range in central Idaho. We tested the hypotheses that habitat characteristics were similar between sites used by translocated grouse and random sites as well as between nest and random sites.

STUDY AREA

Sawtooth Valley is at the headwaters of the Salmon River in central Idaho (Tuhy 1981). The valley is approximately 30 km long, 3–5 km wide, and 1960–2250 m in elevation. It is flanked to the west by the Sawtooth Mountains (>3200 m) and to the east by the White Cloud Mountains (>3500 m). The periphery of Sawtooth Valley is composed of rolling glacial moraines with slopes >10°. The valley floor is composed of glacial and alluvial deposits with slopes 0–5° (Tuhy 1981).

Average annual precipitation is 26 cm and average annual temperature is 6.5° C. The valley averages 2.5 m of snow, which accounts for 85% of the annual precipitation (Tuhy 1981). Sagebrush cover dominates approximately 125 km^2 (75%) of Sawtooth Valley. Mountain big sagebrush/Idaho fescue (*Festuca idahoensis*) is the major habitat type (Tuhy 1981).

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Wet meadows and riparian areas cover 19 km^2 (11%) of the valley, irrigated pastures 19 km^2 (11%), and isolated stands of lodgepole pine (*Pinus contorta*) 3 km^2 (2%; Musil 1989).

METHODS

During late March and early April 1986 and 1987, we captured 196 Sage Grouse (46 adult females, 19 yearling females, 115 adult males, 16 yearling males) by spotlight trapping (Giesen et al. 1982) on 11 leks from nonmigratory populations (J. W. Connelly personal observation) in southeastern Idaho. Capture areas were at similar elevations approximately 144 km from Sawtooth Valley. Grouse were classified to age and sex (Dalke et al. 1963) and leg-banded at the capture site. Males were transported in wooden crates and females were moved individually in modified cardboard boxes to reduce head-scalping and other injuries (Patterson 1952). Birds were transported by truck to Sawtooth Valley each morning after capture and moved by snowmobiles to the release site adjacent to the last active lek. Releases occurred from 19 March to 6 April 1986 and 25 March to 1 April 1987.

We equipped 44 (22%) grouse (31 females, 13 males) with solar-powered radio-transmitters (Musil 1989, Musil et al. 1993) attached to ponchos (Amstrup 1980). Fifteen grouse (8 females, 7 males) were marked with radios in 1986 and 29 (18 females, 11 males) in 1987. Weight of telemetry packages (<25 g) was <2.2% of the mean body weight of female grouse.

We located birds at least twice per week, equally dividing locations during the day among three periods (Dunn and Braun 1986). We tracked radio-marked birds from the ground using a hand-held 4-element Yagi antenna and receiver (Mech 1983).

Radio-locations were obtained by walking a 15–30-m-radius circle around the signal (Musil et al. 1993). We plotted radio-locations on aerial photographs and 7.5-minute U.S. Geological Survey orthoquadrangle topographic maps overlaid with the Universal Transverse Mercator (UTM) grid system (Lancia 1974) scaled to 100 m^2/grid.

Habitat Characteristics

NEST SITES.—Nests of translocated Sage Grouse were located by telemetry and incidental sighting. Nest site characteristics were measured after nesting efforts ceased. At each nest the number of shrubs in contact with the nest bowl was counted. Height of the shrub over the bowl and area (length × width) of the shrub mass surrounding the nest were measured. Density of shrubs ≤40 cm and >40 cm tall was measured within a 2-m radius of the nest. A cover board (Jones 1968) was placed in the nest, and horizontal cover was estimated at 2 m from the nest at 0° and 45°. The board was also placed flat in the nest and cover at 90° was measured. Four 20-m transects were positioned at cardinal directions intersecting the nest, and shrub cover was measured using the line-intercept method (Canfield 1941). Shrub and grass heights were measured at 5-m intervals along the transects.

To determine whether Sage Grouse were selecting nest sites based on stand characteristics, we established a dependent random plot in 1987 at a random direction and distance 50–300 m from each nest site. A corresponding independent random plot was located by randomly selecting two 5-digit numbers corresponding to the last five numbers of the east and north UTM coordinates covering the study area (167 km^2). To find the independent random plot, we paced the distance along a compass line from the nearest landmark to the point. Only points in sagebrush habitat were used for independent random plots because this is the only habitat used for nesting by this species (Patterson 1952, Petersen 1980, Wakkinen 1990, Connelly et al. 1991).

DAILY USE SITES.—Vegetative and topographic variables were measured at sites used by radio-marked Sage Grouse during May–July 1987. Use plots were centered at radio-locations and selected uniformly among daily use patterns of Sage Grouse (Dunn and Braun 1986). Habitat characteristics were also measured at dependent and independent random plots as described for nest sites.

At each use site we measured vegetation along two parallel 15-m transects placed 8 m apart. Transects were positioned perpendicular to the contour of the slope and centered within a 60-m-radius circle for use sites. Shrub canopy cover was measured by line-intercept (Canfield 1941). Shrub density (plants/m^2) within 0.5 m of each side of the transect was measured, and a clinometer was used to record slope at each vegetation site.

We estimated understory cover with modified Daubenmire (1959) 4 × 5-dm plots at 1.5-m intervals (20 frames/site) along the transects (Mosley et al. 1986). At each Daubenmire plot, heights of the closest live and dead shrub <1 m from the transect were measured.

Locations of vegetation sampling sites were plotted on 7.5-minute orthoquadrangle topographic maps, elevations recorded, and the distance to the nearest change in cover type (i.e., pasture, riparian, wet meadow, or timber) measured with an electronic planimeter.

VEGETATION ANALYSIS.—Depending on normality, univariate parametric or nonparametric statistical tests were used for comparing equality of both means and variances between use and random sites. Separate analyses were conducted for use vs. dependent random sites (matched pairs) and between use and independent random sites using SAS (SAS Institute, Inc. 1985) and Statistix II (Analytical Software, Box 130204, St. Paul, Minnesota 55113) computer programs.

We used logistic regression (Harrell 1985) to identify variables that best distinguished Sage Grouse use from independent random sites. Maximum-likelihood estimates were computed to determine coefficients for variables in the predictive model. The significance level to enter and stay in the logistic regression model was set at .10, and addition of variables to the model was stopped once the X^2 test of the residual variables was no longer significant.

Nonparametric tests were used to compare nests with random plots because of the small sample of nests (n = 6). Wilcoxon's signed rank test (Conover 1980) was used to compare height of the shrub covering the nest and average height of live shrubs along the transects surrounding the nest.

We did not intentionally flush radio-marked grouse; thus flock composition was largely unknown. Occasionally, mixed-sex flocks were flushed, which suggested that plots used for habitat sampling were not represented by one sex. Therefore, we did not compare habitat use by male and female grouse.

RESULTS

Nest Sites

At least one translocated Sage Grouse nested in 1986 and six nested in 1987. Two of the grouse that nested in 1987 were birds released in 1986; the others were released during spring 1987. Vegetation at nest sites (n = 6) did not differ (P > .10) from dependent random plots (Wilcoxon signed rank test, $P \geq .249$ for all values). Although average height of shrubs covering nests ($\bar{x}$ = 50.7 ± 6.7 cm) was greater (P = .04) than average shrub height surrounding nests ($\bar{x}$ = 27.3 ± 4.0), there were no differences in shrub height or cover at nest sites compared with dependent or independent random sites. Grouse nested at sites with greater (P = .03) horizontal cover at a 45° angle to the nest ($\bar{x}$ = 86.0 ± 12.5) than at independent random sites ($\bar{x}$ = 66.9 ± 16.5).

Daily Use Sites

Between 22 May and 23 July 1987, 50 use sites were sampled for 15 (3 males, 12 females) radio-marked grouse, with an equal number of dependent and independent random sites. Dependent random sites averaged 163 ± 16 m from use sites. Grouse used sites with more shrub canopy cover ($P \leq .01$), greater litter cover ($P \leq .01$), and taller live and dead shrubs (P = .00) than at dependent random sites (Table 1). Variance tests indicated few differences in frequency distributions between Sage Grouse use and dependent random sites (Table 1).

Sage Grouse used areas with flatter slopes (P < .01), farther from habitat edges (P = .01), with more litter cover (P = .00), less bare ground (P = .00), and greater density of mountain big sagebrush (P = .04) (Table 1) than at independent sites. Variance tests indicated that grouse used narrower frequency distributions of slope, elevation, live shrub canopy cover, bare ground, density of shrubs other than sagebrush, and live shrub height (P = .00) but wider distributions of distances to edge (P = .00), dead shrub canopy cover (P < .01), total shrub density (P = .03), and dead shrub height (P = .00) (Table 1).

Two variables were identified by logistic regression to best separate use sites from independent random sites. Distance from edge and mountain big sagebrush density correctly classified 64% of the use sites and 78% of the independent random sites. The probability that a site would be classed as a use site increased as distance from habitat edge and density of mountain big sagebrush increased.

TABLE 1. Habitat characteristics at translocated Sage Grouse use sites, dependent random and independent random sites in Sawtooth Valley, Idaho, 1987.

	Grouse (n = 50)		Dependent (n = 50)		P		Independent (n = 50)		P	
Habitat variable	$\bar{x}$	SD	$\bar{x}$	SD	H_o: equal means[a]	H_o: equal variances	$\bar{x}$	SD	H_o: equal means[a]	H_o: equal variances[b]
Slope (°)	3.4	4.8	2.9	4.4	.66	.00	7.6	8.7	.01	.00
Elevation (m)	2141	37	2139	37	.59	.59	2148	78	.49	.00
Edge distance (m)	392	283	400	271	.63	.77	225	172	.01	.00
Canopy cover (%)										
Mtn. big sage[c]	17.6	6.0	14.9	7.0	.01	.27	16.0	11.0	.19	.00
All sagebrush	17.9	6.3	14.9	7.0	.01	.47	16.7	10.5	.48	.00
Other shrubs	0.7	1.9	0.4	1.4	.15	.00	2.1	5.6	.48	.00
Dead shrubs	4.8	4.5	4.7	4.3	.82	.78	4.2	3.7	.93	.01
Live shrubs	18.5	6.7	15.3	7.3	.01	.50	18.8	11.6	.91	.00
All shrubs	23.3	6.9	20.0	7.5	.00	.53	23.0	11.6	.86	.00
Groundcover (%)										
Forbs	4.9	4.8	4.1	2.5	.69	.06	4.2	4.2	.29	.72
Grass	26.1	10.3	26.2	11.4	.97	.49	23.8	12.3	.30	.22
Litter	29.0	9.7	25.3	10.5	.01	.56	21.3	11.7	.00	.01
Bare ground	31.0	14.0	34.9	14.2	.06	.92	43.7	21.0	.00	.01
Shrub density (plants/m^2)										
Mtn. big sage[c]	1.61	0.68	1.57	0.76	.70	.44	1.28	0.62	.04	.69
All sagebrush	1.66	0.75	1.57	0.76	.48	.98	1.43	0.69	.24	.69
Other shrubs	0.13	0.32	0.12	0.37	.40	.00	0.19	0.42	.32	.00
Dead shrubs	0.68	0.57	0.68	0.58	.95	.92	0.60	0.47	.76	.02
Live shrubs	1.75	0.81	1.69	0.88	.63	.58	1.62	0.75	.71	.52
All shrubs	2.47	1.00	2.37	0.92	.35	.55	2.22	0.73	.16	.03
Shrub height (cm)										
Live	36.3	6.7	31.5	6.2	.00	.59	34.5	11.4	.34	.00
Dead	18.0	9.6	15.5	8.5	<.00	.10	25.8	7.0	.16	.00

[a]Paired t test or Wilcoxon signed rank test depending on normality and equality of variances.
[b]F test or squared ranks test depending on normality.
[c]Mountain big sagebrush.

DISCUSSION

Nest Sites

All nests were under sagebrush, similar to findings for many established populations (Patterson 1952, Klebenow 1969, Wallestad and Pyrah 1974, and Petersen 1980) but somewhat different from Sage Grouse nesting in southeastern Idaho (Connelly et al. 1991). No differences were detected between nest sites and dependent plots in the same stand of sagebrush, but hens did nest under shrubs that were taller than shrubs surrounding the nest. These findings are similar to those reported by Wallestad and Pyrah (1974) and Petersen (1980) for established populations. However, Wakkinen (1990) reported that Sage Grouse in southeastern Idaho nested under taller shrubs with a larger area than shrubs in the same stand. Hens may select tall plants and clumps of shrubs for nest sites because these provide more visual obstruction to predators.

We detected few differences in vegetation between nest sites and independent random sites. Wakkinen (1990) reported similar findings and suggested this indicated an abundance of suitable nesting habitat.

Daily Use Sites

Translocated Sage Grouse in Sawtooth Valley used sites with greater physical obstruction than at dependent random sites, and these may have provided more concealment from predators. Grouse use sites also had greater litter cover, which may be related to shrub cover and live shrub height as well as insect abundance (Patterson 1952, Johnson and Boyce 1990).

In a comparison of summer use sites with independent random plots, grouse used flatter sites near the center of the valley rather than the rolling glacial moraines along the perimeter. The central part of the valley has extensive stands of mountain big sagebrush, whereas mixtures of sagebrush and antelope bitterbrush (*Purshia tridentata*) occur on the moraines. Areas used by grouse had little interspersion of habitat edges when compared to sagebrush along the perimeter of the valley. The perimeter had narrow peninsulas of sagebrush on steeper slopes that extended into lodgepole pine timber. These sites were not used by radio-marked Sage Grouse.

Ratti et al. (1984:1193) tested variances between Spruce Grouse (*Dendragapus canadensis*) use sites and random plots and stated that "these differences indicated a preference for sites having habitat characteristics with less variation than the general environment." Similarly, translocated Sage Grouse used narrower ranges for several microhabitat characteristics, both topographic and structural, compared with habitat available throughout the study site. However, within a stand of sagebrush, translocated grouse selected habitat with greater-than-average values rather than narrower frequency distributions.

Translocated Sage Grouse were not associated with edges of cover types as was reported for grouse in Colorado (Dunn and Braun 1986). Grouse in Sawtooth Valley were associated with greater-than-average structural characteristics of sagebrush within a stand (i.e., taller brush and greater canopy cover). This suggests that variability in habitat structure not only among but also within stands of sagebrush is important to Sage Grouse by providing adequate habitat during different seasons and for diurnal uses (Dunn and Braun 1986).

Characteristics of nesting and summer habitats used by translocated grouse within Sawtooth Valley were generally similar to those reported for established Sage Grouse populations in many parts of the species' range. This similarity suggests that translocations of Sage Grouse, if carefully planned, are a feasible method of augmenting or reestablishing Sage Grouse populations (Musil et al. 1993). Patterson (1952) concluded that restoration of relatively small Sage Grouse populations by translocation was not effective because of the birds' tendency to disperse from the release site. Contrary to Patterson's (1952) findings, Sage Grouse translocated into the Sawtooth Valley remained near the release site (Musil et al. 1993). Dispersal of these birds may have been greatly reduced because they were released during the breeding season, into the relatively insular and isolated Sawtooth Valley, and, perhaps most importantly, into an area with adequate spring and summer habitat.

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LITERATURE CITED

ALLRED, W. J. 1946. Sage Grouse trapping and transplanting. Proceedings of the Western Association of State Game and Fish Commissioners 26: 143–146.

AMSTRUP, S. C. 1980. A radio-collar for game birds. Journal of Wildlife Management 44: 214–217.

AUTENRIETH, R. E. 1981. Sage Grouse management in Idaho. Wildlife Bulletin 9. Idaho Department of Fish and Game, Boise. 238 pp.

BATTERSON, W. M., AND W. B. MORSE. 1948. Oregon Sage Grouse. Oregon Game Commission, Federal Aid in Wildlife Restoration Project 6-R. 29 pp.

CANFIELD, R. H. 1941. Application of the line interception method in sampling range vegetation. Journal of Forestry 39: 388–394.

CONNELLY, J. W., W. L. WAKKINEN, A. D. APA, AND K. P. REESE. 1991. Sage Grouse use of nest sites in southeastern Idaho. Journal of Wildlife Management 55: 521–524.

CONOVER, W. J. 1980. Practical nonparametric statistics. 2nd edition. John Wiley and Sons, New York. 493 pp.

DALKE, P. D., D. B. PYRAH, D. C. STANTON, J. E. CRAWFORD, AND E. F. SCHLATTERER. 1963. Ecology, productivity, and management of Sage Grouse in Idaho. Journal of Wildlife Management 27: 811–841.

DAUBENMIRE, R. F. 1959. A canopy coverage method of vegetational analysis. Northwest Science 33: 43–64.

DUNN, P. O., AND C. E. BRAUN. 1986. Summer habitat use by adult female and juvenile Sage Grouse. Journal of Wildlife Management 50: 228–235.

GIESEN, K. M., T. J. SCHOENBERG, AND C. E. BRAUN. 1982. Methods for trapping Sage Grouse in Colorado. Wildlife Society Bulletin 10: 224–231.

HAMERSTROM, F., AND F. HAMERSTROM. 1961. Status and problems of North American Grouse. Wilson Bulletin 73: 284–294.

HARRELL, F. E., JR. 1985. The logist procedure. Pages 269–293 *in* P. S. Reinhardt, ed., SUGI supplemental library user's guide, version 5 edition. SAS Institute Inc., Cary, North Carolina.

JOHNSON, G. D., AND M. S. BOYCE. 1990. Feeding trials with insects in the diet of Sage Grouse chicks. Journal of Wildlife Management 54: 89–91.

JONES, R. E. 1968. A board to measure cover used by Prairie Grouse. Journal of Wildlife Management 32: 28–31.

KLEBENOW, D. A. 1969. Sage Grouse nesting and brood habitat in Idaho. Journal of Wildlife Management 33: 649–662.

LANCIA, R. A. 1974. A universal grid system for map locations. Wildlife Society Bulletin 2: 72.

MECH, L. D. 1983. Handbook of animal radio tracking. University of Minnesota Press, Minneapolis. 197 pp.

MOSLEY, J. C., S. C. BUNTING, AND M. HIRONAKA. 1986. Determining range condition from frequency data in mountain meadows of central Idaho. Journal of Range Management 39: 561–565.

MUSIL, D. D. 1989. Movements, survival and habitat use of Sage Grouse translocated into the Sawtooth Valley, Idaho. Unpublished master's thesis, University of Idaho, Moscow. 72 pp.

MUSIL, D. D., J. W. CONNELLY, AND K. P. REESE. 1993. Movements, survival, and reproduction of Sage Grouse translocated into central Idaho. Journal of Wildlife Management 57: 85–91.

OAKLEAF, R. J. 1971. The relationship of Sage Grouse to upland meadows in Nevada. Unpublished master's thesis, University of Nevada, Reno. 73 pp.

PATTERSON, R. L. 1952. The Sage Grouse of Wyoming. Sage Books Inc., Denver, Colorado. 341 pp.

PETERSEN, B. E. 1980. Breeding and nesting ecology of female Sage Grouse in North Park, Colorado. Unpublished master's thesis, Colorado State University, Fort Collins. 86 pp.

RATTI, J. T., D. L. MACKAY, AND J. R. ALLDREDGE. 1984. Analysis of Spruce Grouse habitat in north-central Washington. Journal of Wildlife Management 48: 1188–1196.

SAS INSTITUTE, INC. 1985. SAS user's guide: statistics. SAS Institute, Inc., Cary, North Carolina. 956 pp.

SCHOENBERG, T. J. 1982. Sage Grouse movement and habitat selection in North Park, Colorado. Unpublished master's thesis, Colorado State University, Fort Collins. 86 pp.

THOMPSON, W. K. 1946. Live trapping and transplanting Ringnecked Pheasants and Sage Grouse. Proceedings of the Western Association of State Game and Fish Commissioners 26: 133–137.

TUHY, J. S. 1981. Stream bottom community classification for the Sawtooth Valley, Idaho. Unpublished master's thesis, University of Idaho, Moscow. 178 pp.

WAKKINEN, W. L. 1990. Nest site characteristics and spring–summer movements of migratory Sage Grouse in southeastern Idaho. Unpublished master's thesis, University of Idaho, Moscow. 55 pp.

WALLESTAD, R. O., AND D. PYRAH. 1974. Movement and nesting of Sage Grouse hens in central Montana. Journal of Wildlife Management 38: 630–633.

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